numerous papers. His capacity for dealing in this way with huge masses of figures was amazing. I have often gone with him over the details of daily maps exhibiting the results for Scottish weather at official stations, lighthouses, and private stations to trace some generalization which had been suggested by his work. His program was to correlate these daily maps with the observations at the summit and base of the mountain. The methodical care in ordering the entries, and their arrangement as regards color or design, to bring out any salient features, were thoroughly characteristic of his work.

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In thus taking leave of a kindly master and a valued friend, it is not too much to say that the work of Buchan's life has contributed largely to justify the claim of meteorology to be regarded as a separate scientific subject, entitled to separate academic recognition. The physics of the atmosphere has its geographical aspect, but it is not a branch of geography; it has its mathematical aspect, but it is not a branch of mathematics; it has its experimental aspect, but it is not a branch of experimental physics. The constitutional affection of the throat prevented Buchan from using his natural powers of exposition to their full extent, but may we not hope that the University of Edinburgh will see her way to recognize the devotion of her distinguished alumnus by providing the subject of his devotion with a voice among the sciences which she fosters?

RESOLUTIONS ADOPTED AT THE MILAN CONFERENCE FOR SCIENTIFIC AERONAUTICS.[1]

Translated by Prof. A. LAWRENCE ROTCH.

The following resolutions were adopted by the commission:

1. For the official publication, the observations should be formulated according to the rules adopted and indicated in the report of the president. It is necessary that all the small inversions of temperature should be noted.

2. (*a*) The commission, on the proposition of Mr. Teisserenc de Bort, realizing the great importance of collecting sufficient observations to construct charts of the meteorological elements at various heights under different atmospheric conditions, believes that its efforts should be concentrated upon four groups of ascensions annually, called "grand international ascensions", to distinguish them from the monthly ascensions. These last are optional for stations that do not make aerial soundings their chief work.

(*b*) The quarterly ascensions will be made during three consecutive days, on dates to be fixt hereafter.

(*c*) It is recommended that the trajectories of the sounding balloons shall be determined by sighting, and that the same thing be done for pilot balloons, if no sounding balloons are launched, as will be the case at insular stations; in any case the drift of the clouds must be observed with great care. The new series will commence in March, 1907.[2]

3. It is also desirable, as Mr. Rykatchef suggested, to have at least one temporary station for these international observations in the midst of the great Asiatic anticyclone, especially in winter. If this station can be established, observations in winter should last seven days instead of three—that is to say, two days before and two days after the three normal days.

4. To examine the proposition of Mr. Köppen, the conference appoints a subcommittee composed of Messrs. Berson, Hergesell, Köppen, de Quervain, Rotch, and Teisserenc de Bort, which proposes—

(*a*) To adopt the proposition of Mr. Köppen to publish a compendium of the best methods employed for aerial soundings. This compendium will describe the methods and instruments categorically, in a form analogous to that of a dictionary, and the various institutions conducting aerial soundings will be consulted as regards the final version. The publication will be made with the funds of the international commission applicable to the publication of observations.

(*b*) The same subcommittee examined the question relating to the statistical table of ascensions. The form adopted by the Deutsche Seewarte is recommended for the kites, and the institutions are requested to give annually a similar résumé for the balloons.

5. The commission votes its thanks to Messrs. Teisserenc de Bort and Rotch for their splendid researches in the atmosphere above the Atlantic Ocean, and to the Imperial Minister of Marine for the participation of the German Marine in the exploration of the high atmosphere. It listens with interest to the communications of Messrs. Köppen and Hergesell relating to the results of the cruise of the ship *Planet*, which is to advance further the conquest of these unknown regions, and sends a congratulatory dispatch to the Prince of Monaco for the explorations accomplished by his yacht, the *Princesse Alice*.

6. The commission expresses its thanks to the Spanish Minister of War for allowing the military aeronauts to cooperate in the work of the commission, and particularly for the interesting researches made during the eclipse of the sun on August 30, 1905.

7. The commission recognizes with great pleasure the institution of aerial soundings by the Weather Bureau of the United States at Mount Weather, and hopes that these soundings will be extended to other stations of the service.

8. The conference agrees with Major Moedebeck that it would be useful, both for scientific ascensions and for aeronautics in general, if, on the topographic maps of the States, there should be indicated in red the luminous points which can serve for orientation at night, and also if all lines of dangerous electric wires as well as the places most sheltered from the wind should be marked on the maps.

9. The commission accepts Mr. Assmann's propositions with these slight modifications:

(*a*) The commission shall meet but once in three years unless there be especial reasons for assembling oftener.

(*b*) The meetings will be for the purpose of discussing the organization of the work, the methods and instruments, and scientific communications will be presented only at the end of the meetings if time permits.

10. The proposition of Mr. von Bassus is adopted to add to the form containing the reduction of the ascensions of sounding balloons, another column headed "Wind", and having subheadings for "Direction" and "Velocity". The lines of these columns and also those of the columns "Gradient" and "Ventilation" are to be doubled. The notes at the foot of the second page will indicate that up to 3000 meters the reduction should be made for each 500 meters, and above 3000 meters that it should be for each 1000 meters. All inversions, isothermal strata, and sudden changes of wind and humidity are to be noted.

11. It is desirable that the negotiations be continued, looking to the establishment of a seal of the International Commission for Scientific Aeronautics.[3]

GUILBERT'S RULES FOR WEATHER PREDICTION.

By OLIVER L. FASSIG, Research Director. Dated Mount Weather Observatory, Bluemont, Va., November 2, 1906.

In earlier numbers of the REVIEW (November, 1904, and January, 1905)[1] were published two letters relating to a proposed international competition at Liège, organized by the Belgian Astronomical Society, in order to bring out the present state of the art of predicting the weather. This competition was attended by several experts, some of whom have published their methods in full in accordance with the requirements of the jury of awards. The paper presented by M. Gabriel Guilbert, of Caen, was dated September 28, 1905, and attracted the most attention, as it contained a principle of forecasting that had not been employed or announced before.

The jury, composed of six well-known meteorologists, of whom Mr. A. L. Rotch, of Blue Hill Observatory, was the

[1] See Monthly Weather Review, April, 1907, vol. XXXV, p. 181.

[2] Subsequently postponed until July. – *A. L. R.*

[3] This would insure the instruments entering the different countries without examination by customs officers.—*A. L. R.*

[1] Vol. XXXII, page 523, and vol. XXXIII, page 11.

American representative, unanimously awarded the first prize to Mr. Guilbert for the method which enabled him to predict with precision the displacements and variations of centers of high and low pressure over Europe. Depressions and high areas invisible on the weather map when interpreted by methods heretofore used, were predicted by Mr. Guilbert. The author claims to be able to forecast radical changes in the barometric situation, both as to the form and the movement of the centers of high and low areas, for twenty-four hours in advance, with a precision far above that afforded by present methods. Heretofore the forecaster has to a very large extent assumed that a depression already discernible upon the weather map would follow a path already indicated by its previous movement, and that it would follow this path with but slight modifications in form or intensity. It was only in rare cases that a forecast of the *formation* of a low or high area was attempted. According to the statements of Mr. Guilbert he is able by his method to foretell the *inception* and the *dissolution* of storms.

Guilbert's new method is based upon what he terms the principle of the *normal wind*. The normal wind is defined as a wind whose force is directly proportional to the barometric gradient. Thus, on a scale of 0 to 9, a light wind (force 2) is normal for a gradient of 1 mm. per geographical degree of 111 km.; a moderate wind (force 4) is normal for a gradient of 2 mm., etc. This scale is given more in detail in the following paragraphs.

Guilbert's rules have been summarized by M. Brunhes, the chairman of the jury of award, who has contributed a valuable theoretical discussion of the rules (see Archives des Sciences Physiques et Naturelles for July, 1906).

According to M. Brunhes, the three rules announced by Guilbert may be summarized as follows:

1. Every depression that gives birth to a wind stronger than the normal will fill up more or less rapidly. On the other hand, every depression that forms without giving rise to winds of corresponding force will deepen, and often depressions that are apparently feeble will be transformed into true storms.

2. When a depression is surrounded by winds having varying degrees of excess or deficiency, as compared with the normal wind, it moves toward the region of least resistances. These favorable areas are made up of regions in which the winds are relatively light, and especially of such as have divergent winds with respect to the center of the depression.

3. The rise of pressure takes place along a direction normal to the wind that is relatively too high, and it proceeds from right to left; an excessive wind causes a rise of pressure on its left.

The results attained by Mr. Guilbert in the international competition were so far superior to those of any of his competitors that his methods are worthy of the closest study. A translation is here given of the paper presented by the author in which his new method is worked out in detail. How far the successful forecasting of Mr. Guilbert in this competition was due to the principle announced and how much is to be attributed to the cumulative experience of the forecaster remains to be demonstrated. The rules can be readily put to the test of experience, and the paper of Mr. Guilbert should receive the careful consideration of all who make weather forecasts.

PRINCIPLES OF FORECASTING THE WEATHER.

By GABRIEL GUILBERT, of Caen. Dated Liège, Belgium, September 28, 1905. [Translated by O. L. Fassig.]

The method which we employ in forecasting the weather at short range is based on the principle of the *normal wind*.

The normal wind is that whose force is directly proportional to the barometric gradient.

In the scale of winds from 0 to 9, a *light* wind (force 2) is *normal* for a gradient of 1 mm. per geographic degree of 111 km.

A *moderate* wind (force 4) is normal for a gradient of 2 mm.

A *fresh* wind (force 6) is normal for a gradient of 3 mm.

A *high* wind (force 8) is normal for a gradient of 4 mm.

In departing from these proportional coefficients, the winds are abnormal either by *excess* or by *deficiency*. Thus, 3 will be abnormal by *excess* for a gradient of 1 mm. per degree; in like manner 5, 7, and 9, for gradients of 2, 3, and 4 mm., respectively:

Inversely a calm (0) will be *abnormal by deficiency* for a gradient of 1 mm.; similarly 3, 5, and 7, for gradients of 2, 3, and 4 mm., respectively.

We have cited anomalies of but small importance, but it is not rare in observations to find 7 with a gradient of 2 mm., 9 with 3 mm., and, inversely, 3 or 4 with a gradient of 3 mm.

As a result of this scale and this principle, high winds and even gales can be *abnormal by deficiency*, that is to say, relatively too light for the gradient considered; and, inversely, light or moderate winds may be *abnormal by excess* in considering the gradient referred to.

Of course, these coefficients of wind force are at present dependent upon the estimation of observers, and science will some day require anemometric measures; but, in the meantime, the approximate estimate of this velocity of the air at the surface of the earth, *and at the surface only*, is sufficient for making a forecast *twenty-four hours in advance* of variations of pressure, whether rising or falling.

We maintain that no depression can subsist unless there be as complete equilibrium as possible between the force of the wind which it causes and the gradient which it forms.

To produce this equilibrium the force of the wind must be proportional to the gradient; there is then equality between the *centripetal* and *centrifugal* forces which are in constant struggle in every barometric depression. The gradient represents the centrifugal force, the wind the centripetal force. If at any point of a cyclone one of the forces predominates, there is a change in the form of the cyclonic whirl.

This change will take place in the direction of extension if the centrifugal force represented by the gradient is greater than the relatively feeble force of the wind. If, on the contrary, it is the centripetal force, represented by the velocity of the wind, which is the stronger, the whirl will undergo a *reduction* more or less noticeable.

Consequently, in application, with a wind *abnormal by excess*, there will be a *rise in pressure*, generally *proportional to the excess* of the wind observed.

Inversely, with a wind *abnormal by deficiency*, there will be a *fall in pressure* directly proportional to the importance of the observed anomaly.

With a *normal* wind the variations in pressure will be *nil* or slight.

It follows from this law and these observations that the wind is in reality *the enemy of the depression;* that it is centripetal, in *conflict* with the centrifugal force represented by the gradient; that it has the power to fill up cyclonic storms and cause them to disappear.

Hence, every depression which gives rise to winds above the normal in force will fill itself up more or less rapidly, in whole or in part.

Depressions arriving from the ocean, which give rise to too high winds, can not advance, but remain stationary, or may even be forced back toward their place of origin.

Every depression which is completely surrounded by winds, *abnormal by excess*, will be filled up *in place* within twenty-four hours, often even in twelve hours; this is the phenomenon which we designate under the name of COMPRESSION OF THE CYCLONE.

On the contrary, every depression, which gives rise to a marked fall in pressure, without causing winds of correspond-